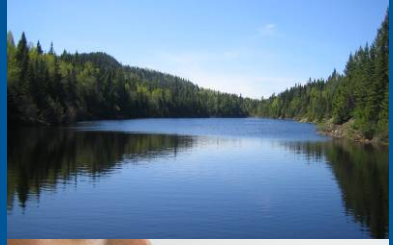







Real-Time Water Quality Report

Waterford River at Kilbride

Deployment Period
February 17, 2016 to March 22, 2016

Newfoundland Labrador

Government of Newfoundland & Labrador
Department of Environment and Conservation
Water Resources Management Division

Waterford River at Kilbride, Newfoundland and Labrador

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General

The Water Resources Management Division (WRMD), in partnership with Water Survey of Canada - Environment Canada (WSC-EC), maintain a real-time water quality and water quantity monitoring station on Waterford River at Kilbride.

This deployment report discusses water quality related events occurring at this station.

The purpose of the real-time water quality station is to monitor process and publish real-time water quality data.

This report covers the period from deployment on February 17, 2016 until March 22, 2016

Figure 1: Waterford River at Kilbride Real-Time Water Quality and Quantity Station.

Quality Assurance and Quality Control

As part of the Quality Assurance and Quality Control protocol (QA/QC), an assessment of the reliability of data recorded by an instrument is made at the beginning and end of the deployment period. The procedure is based on the approach used by the United States Geological Survey.

At deployment and removal, a QA/QC Sonde is temporarily deployed alongside the Field Sonde. Values for temperature, pH, conductivity, dissolved oxygen and turbidity are compared between the two instruments**.** Based on the degree of difference between the parameters on the Field Sonde and QA/QC Sonde at deployment and at removal, a qualitative statement is made on the data quality (Table 1).

WRMD staff (Environment and Conservation (ENVC)) is responsible for maintenance of the real-time water quality monitoring equipment, as well as recording and managing the water quality data. Tara Clinton, under the supervision of Renee Paterson, is ENVC's main contact for the real-time water quality monitoring operation at Waterford River station, and is responsible for maintaining and calibrating the water quality instrument, as well as grooming, analyzing and reporting on water quality data recorded at the station.

WSC staff (Environment Canada (EC)) under the management of Howie Wills, play an essential role in the data logging/communication aspect of the network and the maintenance of the water quantity monitoring equipment. WSC-EC staff visit the site regularly to ensure the data logging and data transmitting equipment are working properly. WSC is responsible for handling stage and streamflow issues. The quantity data is raw data that is transmitted via satellite and published online along with the water quality data on the Real-Time Stations website. Quantity data has not been corrected or groomed when published online or used in the monthly reports for the stations. WSC is responsible for QA/QC of water quantity data. Corrected stage and streamflow data can be obtained upon request to WSC.

Table 1: Instrument Performance Ranking classifications for deployment and removal

	Rank				
Parameter	**Excellent**	**Good**	**Fair**	**Marginal**	**Poor**
Temperature (°C)	<=+/-0.2	>+/-0.2 to 0.5	>+/-0.5 to 0.8	>+/-0.8 to 1	<+/-1
pH (unit)	<=+/-0.2	>+/-0.2 to 0.5	>+/-0.5 to 0.8	>+/-0.8 to 1	>+/-1
Sp. Conductance (µS/cm)	<=+/-3	>+/-3 to 10	>+/-10 to 15	>+/-15 to 20	>+/-20
Sp. Conductance > 35 µS/cm (%)	<=+/-3	>+/-3 to 10	>+/-10 to 15	>+/-15 to 20	>+/-20
Dissolved Oxygen (mg/L) (% Sat)	<=+/-0.3	>+/-0.3 to 0.5	>+/-0.5 to 0.8	>+/-0.8 to 1	>+/-1
Turbidity <40 NTU (NTU)	<=+/-2	>+/-2 to 5	>+/-5 to 8	>+/-8 to 10	>+/-10
Turbidity > 40 NTU (%)	<=+/-5	>+/-5 to 10	>+/-10 to 15	>+/-15 to 20	>+/-20

It should be noted that the temperature sensor on any sonde is the most important. All other parameters can be divided into subgroups of: temperature dependant, temperature compensated and temperature independent. Due to the temperature sensor's location on the sonde, the entire sonde must be at a constant temperature before the temperature sensor will stabilize. The values may take some time to climb to the appropriate reading; if a reading is taken too soon it may not accurately portray the water body.

Table 2: Instrument performance rankings for Waterford River at Kilbride

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Waterford	Feb 17	Deployment	Excellent	Good	Good	Excellent	Excellent
	Mar 22	Removal	Excellent	Excellent	Excellent	Excellent	Excellent

On deployment, the rankings of the field data against the QAQC data indicated that; water temperature, dissolved oxygen and turbidity all ranked as 'Excellent'. With pH data and conductivity data ranking as 'Good'

At removal of the instrument, all the rankings for the water quality parameters were 'Excellent'.

Waterford River at Kilbride

Water Temperature

Water temperature ranged from -0.10°C to 5.22°C during this deployment period (Figure 2).

The water temperature at this station displays diurnal variations although slightly elongated due to the depth of water at this station. Deeper streams are influenced more subtlety by natural diurnal variations in air temperatures (Appendix I).

There is a evident warmer period in water temperature from February 25th to March 4th. During the higher stage events there is more movement in the water temperature data values. Despite several larger increases in water temperature the data remains reasonably consistent with a slight decrease as deployment ends.

Please note the stage data is raw data that is published on the ENVC web page. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

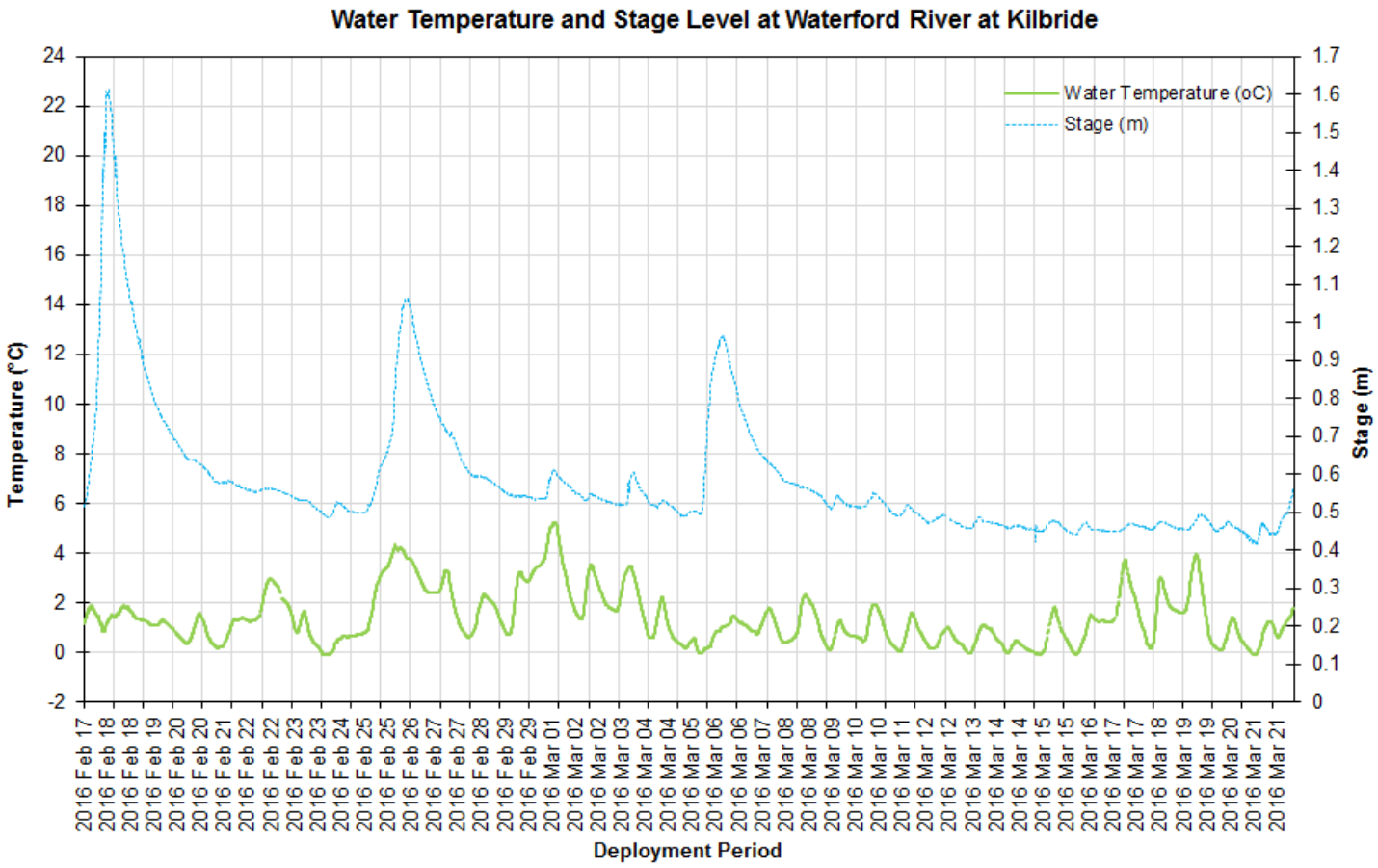

Figure 2: Water temperature (°C) and Stage (m) values at Waterford River at Kilbride

pH

Throughout the deployment period, pH values ranged between 6.74 pH units and 7.20 pH units (Figure 3).

The pH levels are consistent; however during high stage levels the pH data decreased slightly. Despite these small dips in pH the values did not drop below the minimum CCME guideline for the Protection of Aquatic Life Guideline. The pH levels stayed within this range for the entire deployment period.

The CCME guideline provides a basis by which to judge the overall health of the brook. Naturally, all streams and brooks are different. During the deployment period the median pH level was 7.03 pH units.

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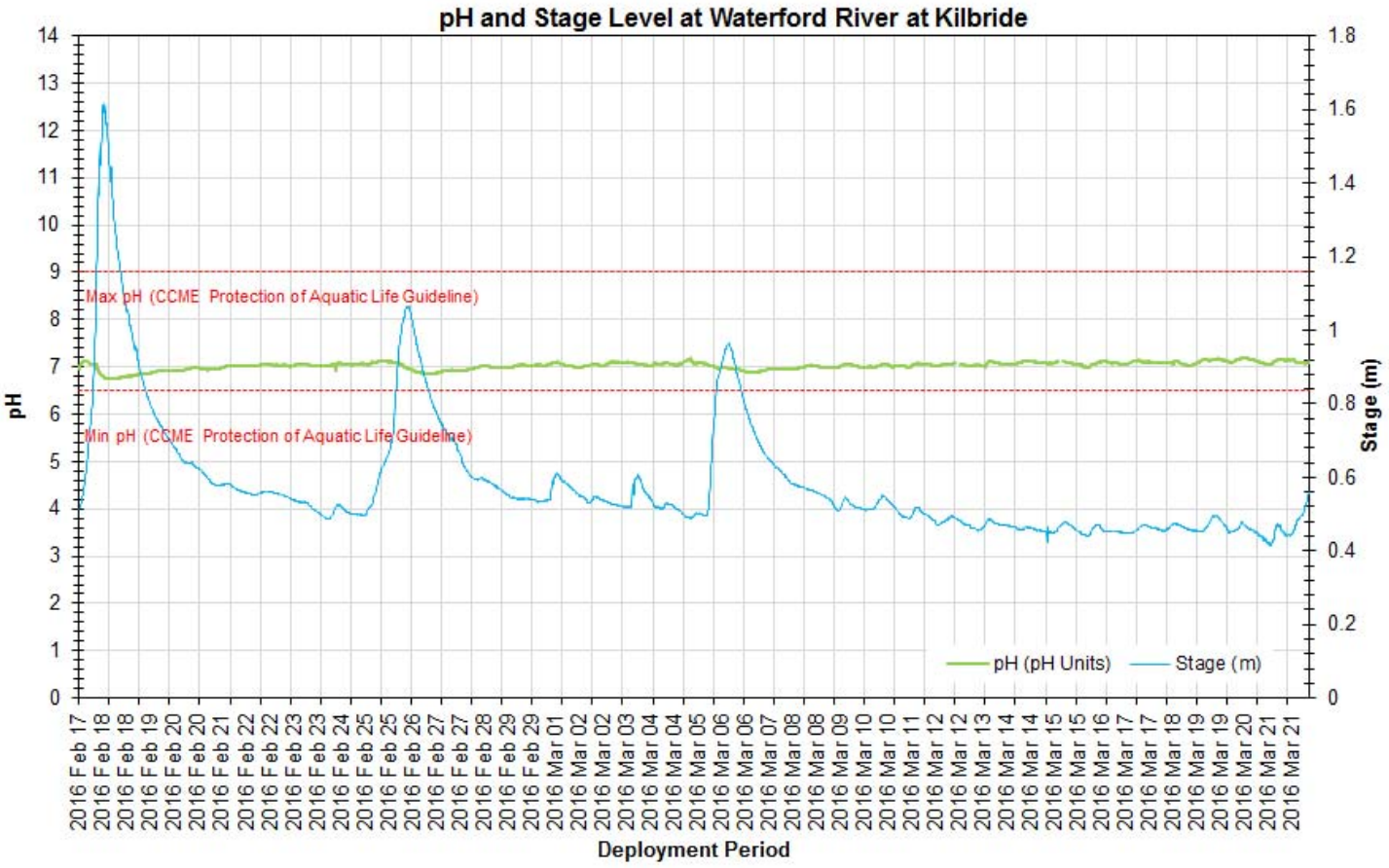

Figure 3: pH (pH units) and stage level (m) values at Waterford River at Kilbride

Specific Conductivity & Total Dissolved Solids

The conductivity levels were within 541.0 µS/cm and 2992.0 µS/cm during this deployment period. TDS (a calculated value) ranged from 0.3520 g/L to 1.9440 g/L (Figure 4).

Commonly the relationship between conductivity and stage level is inversed. When stage levels rise, the specific conductance levels drop in response as the increased amount of water in the river system dilutes the solids that are present. This is evident on February 18th, February 26th and March 6th. However during these times the conductivity levels increase significantly before decreasing with the high stage levels (as noted on Figure 4).

Spikes in conductivity, can be a result of road salting or runoff into the brook. Any additional material and dissolved substances present in the brook are captured by the conductivity probe. The end of the deployment period displays several high conductivity events without any increase in stage. This was likely a result of road salting at these times.

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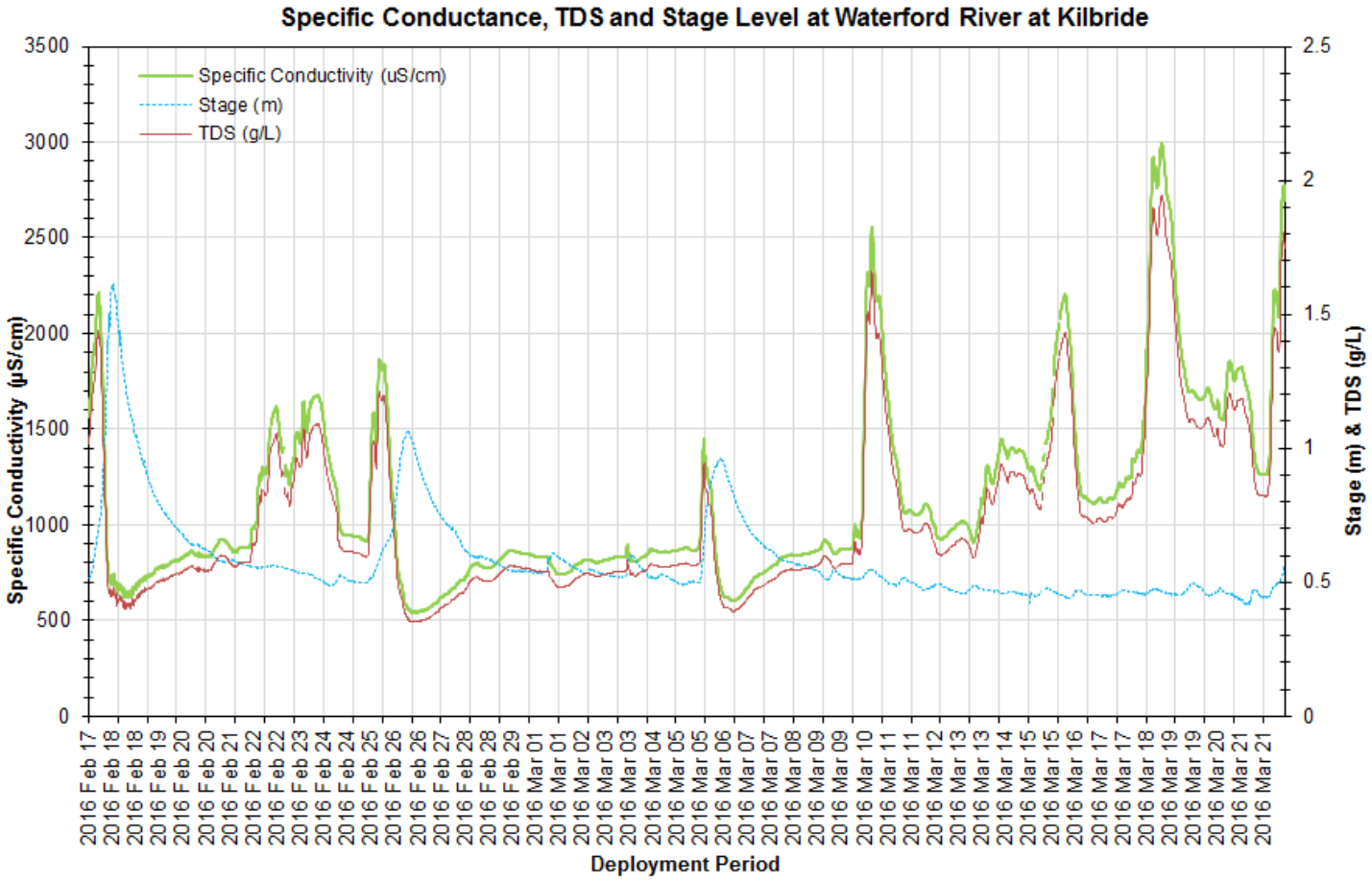

Figure 4: Specific conductivity (µS/cm), TDS (g/L) and stage (m) values at Waterford River at Kilbride.

Dissolved Oxygen

The water quality instrument measures dissolved oxygen (mg/L) with the dissolved oxygen probe and then the instrument calculates percent saturation (% Sat) with water temperature.

During the deployment the dissolved oxygen concentration levels ranged within a minimum of 12.31 mg/L to a maximum of 14.63 mg/L. The percent saturation levels for dissolved oxygen ranged within 95.0 % Saturation to 101.1 % Saturation.

Dissolved oxygen remained above the maximum CCME guideline for the Protection of Early Life Stages for the entire deployment period. The cooler water temperatures allow for larger amounts of dissolved oxygen to be present in the brook. The dips in dissolved oxygen on Figure 5 coincide with warmer water temperatures for the same time frame.

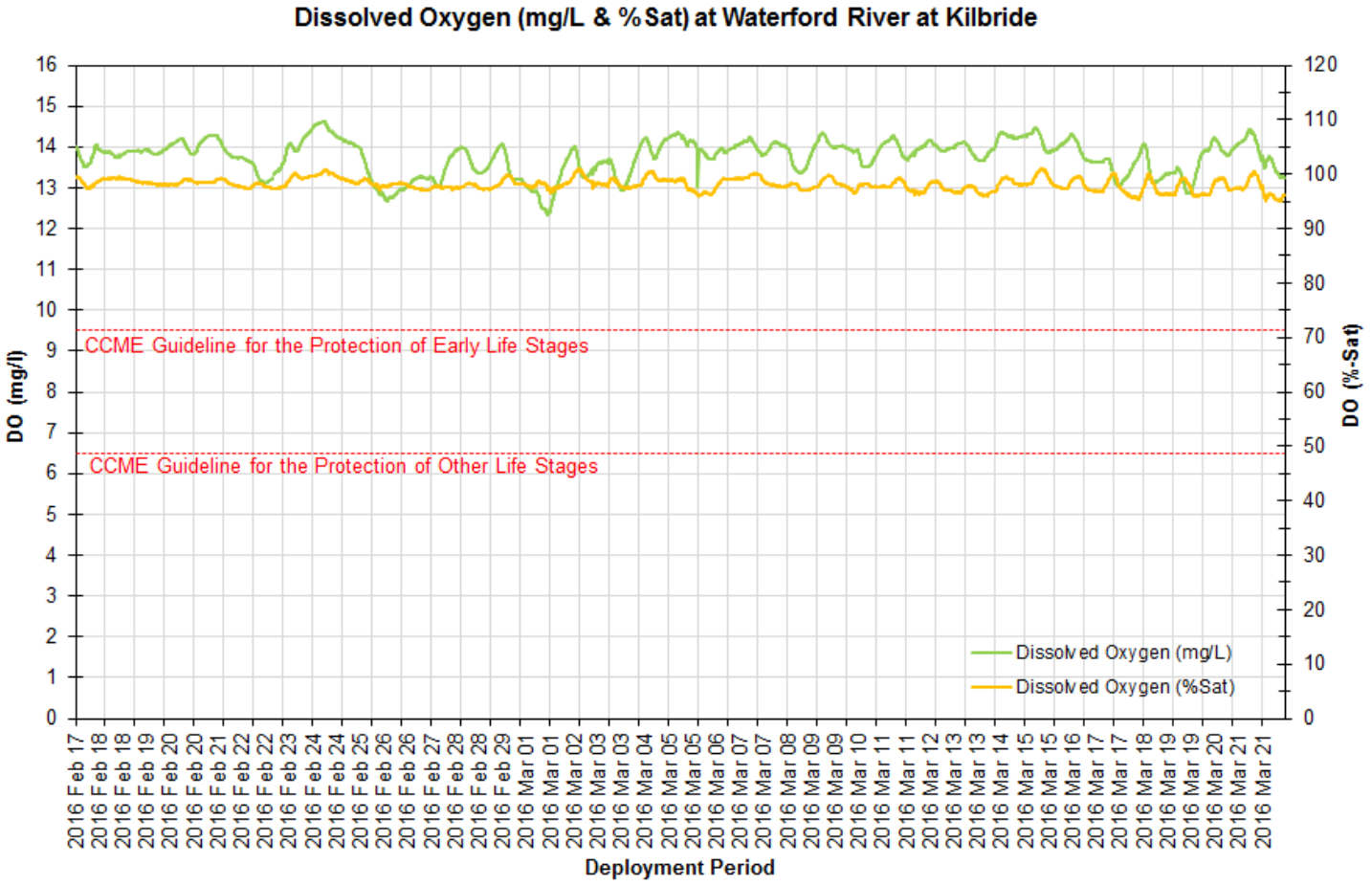

Figure 5: Dissolved Oxygen (mg/L & Percent Saturation) values at Waterford River at Kilbride.

Turbidity

Turbidity levels during the deployment ranged within 0.6 NTU and 913.1 NTU (Figure 6). The deployment data had a median of 1.8 NTU.

The higher turbidity events in the deployment period correlate with increases in stage potentially from precipitation. Precipitation can increase the presence of suspended material in water. The turbidity data does return to lower levels after the high peaks.

The turbidity data from February 18th to February 24th was removed due to fouling on the turbidity sensor. The data was indicating that there was a blockage on the sensor preventing usable data to be recorded.

Turbidity levels can change quickly at Waterford River. This brook has a significant streamflow rate (this deployment median was 1.67 m^3/s) which can flush the turbid water or sediments from the brook. Being an urban brook in the heart of the City of St. John's the turbidity values in this brook can be heavily influenced by its surroundings.

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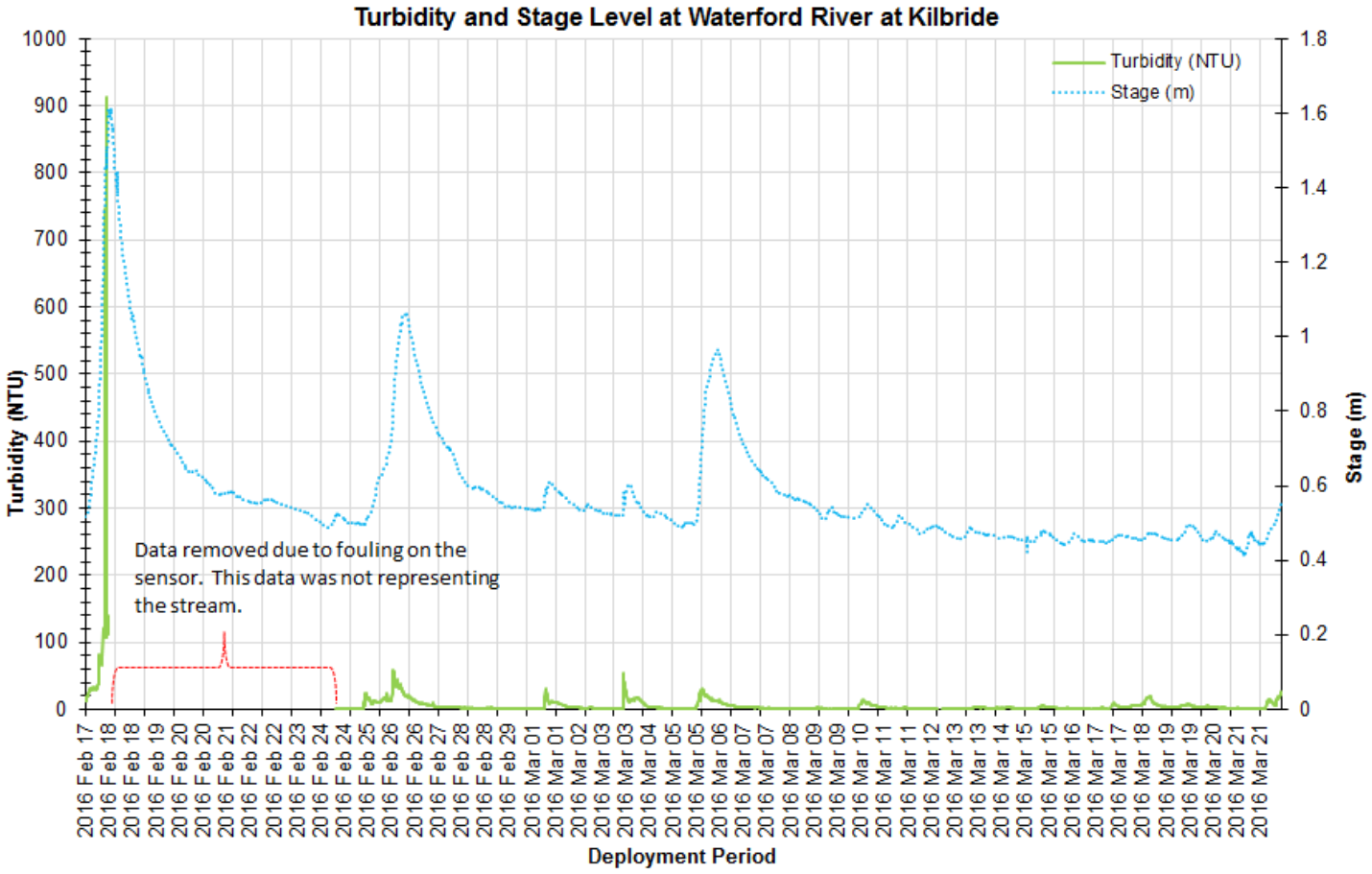


Figure 6: Turbidity (NTU) and stage level (m) values at Waterford River at Kilbride.

Stage and Precipitation

Please note the stage data graphed below is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

Stage is important to display as it provides an estimation of water level at the station and can explain some of the events that are occurring with other parameters (i.e. Specific Conductivity, DO, turbidity). Stage will increase during rainfall events (Figure 7) and during any surrounding snow or ice melt as runoff will collect in the brooks. However, direct snowfall will not cause them to rise significantly.

During the deployment period, the stage values ranged from 0.42m to 1.62m. The larger peaks in stage do correspond with substantial rainfall events as noted on Figure 7.

Precipitation data was obtained from Environment Canada's St. John's Airport weather station. Precipitation ranges for the deployment period were a minimum of 0.0 mm and a maximum of 18.8 mm on March 5th, 2016.

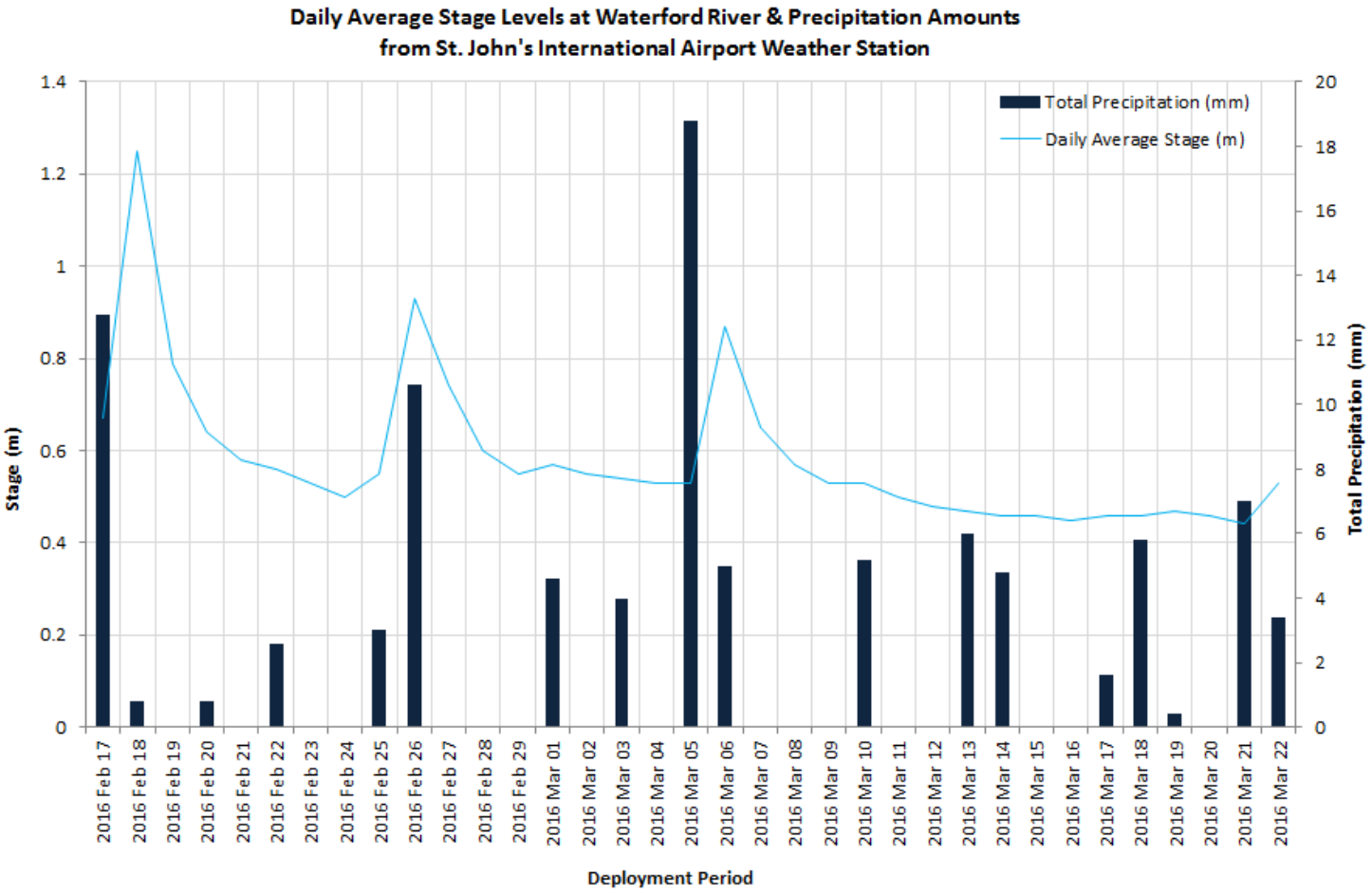


Figure 7: Daily average stage values at Waterford River at Kilbride and daily total precipitation from St. John's Airport Weather Station.

Conclusion

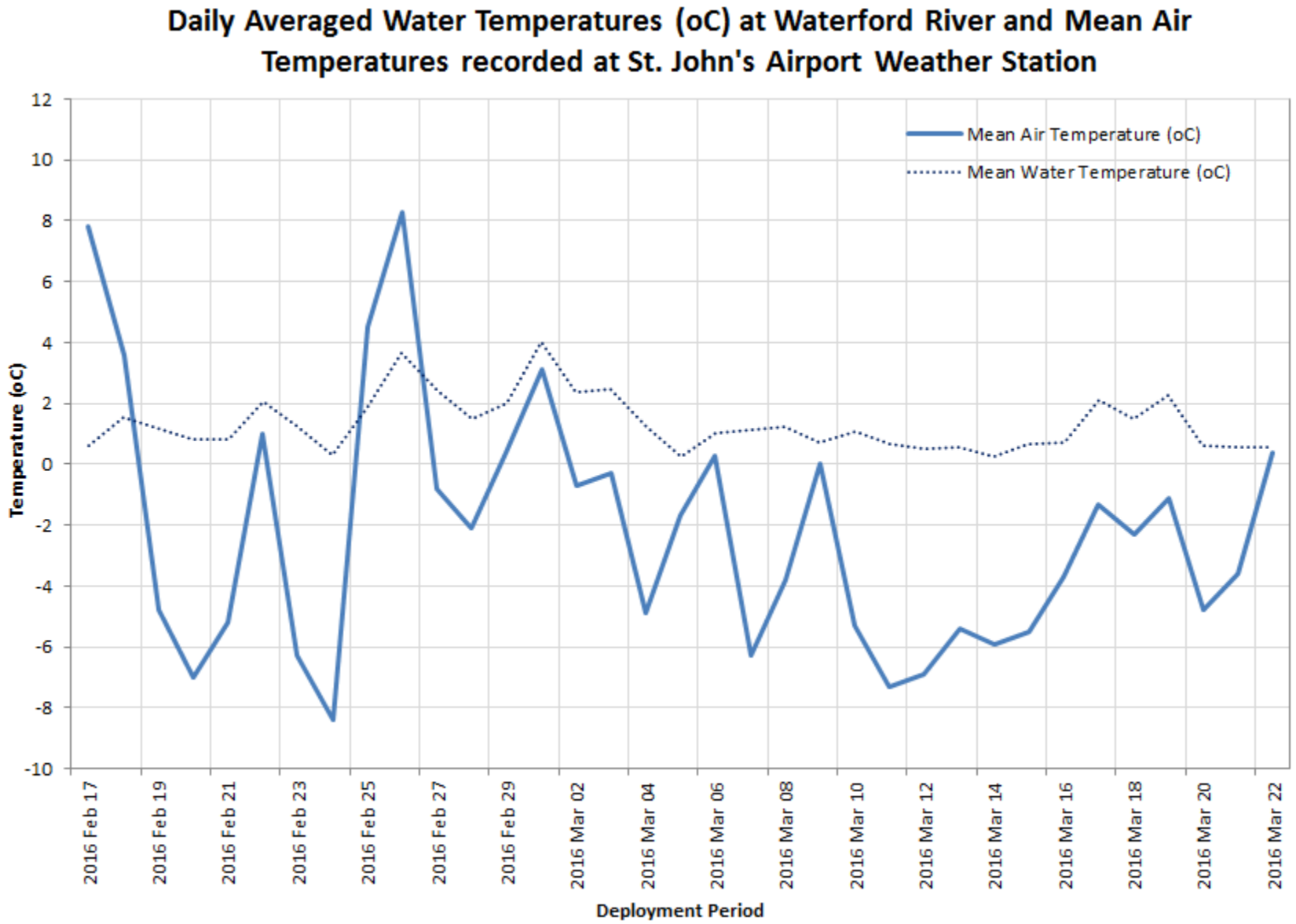
As with many urban brooks and streams, precipitation and runoff events play a role in influencing the water quality within the water body. Waterford River at Kilbride flows through significant developed areas, including residential and industrial zones, the brook can also be found along the boundaries of heavily used road ways, all these factors can influence the parameters that are recorded by the water quality instrument.

It is evident by the recorded data that precipitation events have influenced fluctuations in stage. When reviewing the graphs as a whole it is evident that the larger precipitation events did create varying effects with the water quality parameters pH, conductivity, dissolved oxygen and turbidity.

The pH values during deployment are representative of the changes in the stage level. Conductivity levels were a result of high stage levels and likely rainfall events. High peaks in conductivity during low stage levels are likely a result of salting on roadways. Dissolved oxygen concentration (mg/L) was influenced by the cooler water temperatures. Turbidity had a several events but they were also during high stage levels and rainfall periods. After stage settled down the turbidity returned to normal.

Despite some changes in the water quality parameters during the higher stage events the data was as expected of an urban brook during this time of the year. After each event the data for all the parameters returned to its previous levels. Overall the water quality parameters recorded at Waterford River at Kilbride displayed natural events expected of a brook in an urbanized environment.

APPENDIX I


Daily Averaged Water Temperatures (oC) at Waterford River and Mean Air Temperatures recorded at St. John's Airport Weather Station
Mean Air Temperature (oC)
Mean Water Temperature (oC)
Temperature (oC)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
2016 Feb 17
2016 Feb 19
2016 Feb 21
2016 Feb 23
2016 Feb 25
2016 Feb 27
2016 Feb 29
2016 Mar 02
2016 Mar 04
2016 Mar 06
2016 Mar 08
2016 Mar 10
2016 Mar 12
2016 Mar 14
2016 Mar 16
2016 Mar 18
2016 Mar 20
2016 Mar 22
Deployment Period